LUBRICATION

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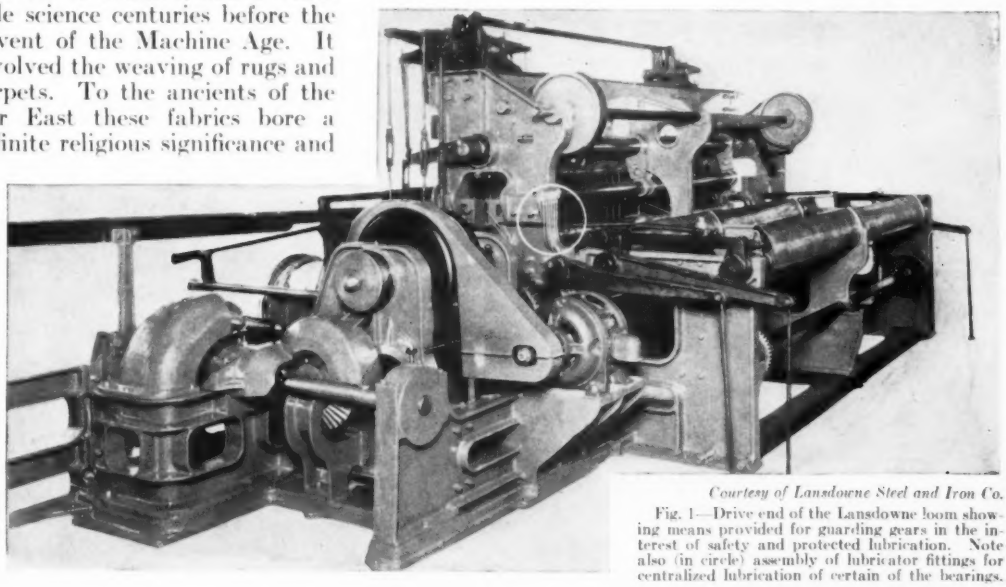
Lubrication in the Rug and Carpet Industry

SOME thousand years before the Christian Era, an industry was born through prayer. It had already become an art before engineering had progressed sufficiently to accept the theories of Gallileo, and a veritable science centuries before the advent of the Machine Age. It involved the weaving of rugs and carpets. To the ancients of the Far East these fabrics bore a definite religious significance and embodied in their designs an historic record as visualized by the weavers.

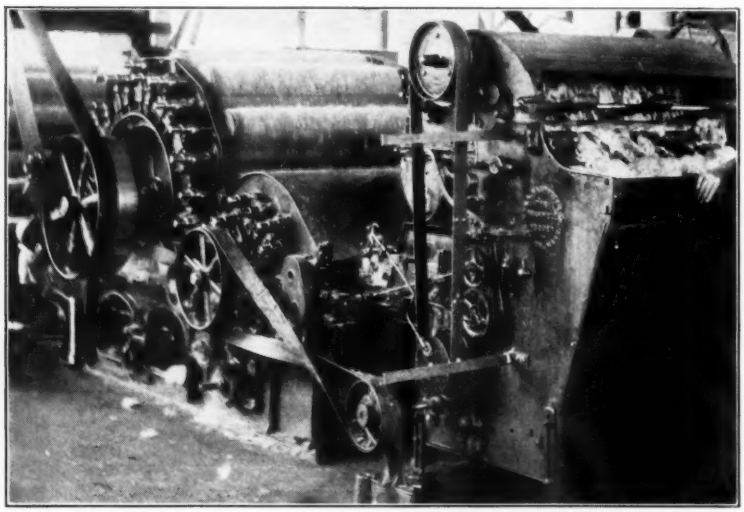


Courtesy of Lansdowne Steel and Iron Co.

Fig. 1—Drive end of the Lansdowne loom showing means provided for guarding gears in the interest of safety and protected lubrication. Note also (in circle) assembly of lubricator fittings for centralized lubrication of certain of the bearings.

Antiquarians attribute the earliest developments in rug weaving to the East; Turkey, Persia and, in fact, the entire area extending to China being involved. The primary purpose of the rug among certain of the early orientals was for devotional kneeling; to others it was their only article of decoration, serving at the same time a useful purpose as a covering for doors and windows. Later it was used as a covering for chairs and divans at banquets and for sleeping purposes. Apparently throughout, the rug was revered and respected as exempli-

fied by the custom of weaving tribal or family designs of remarkable similarity yet equally remarkable difference for no two orientals are quite alike in pattern; the latter being formed by knotting tufts of woolen yarn into the warp.



Courtesy of Alexander Smith & Sons Carpet Co.

Fig. 2—View of a card with moving parts exposed to show operating elements. These are normally guarded to protect the wool, to prevent contamination of lubricants, and to protect operators.

Repetition of pattern was made possible, however, when rug and carpet weaving was introduced into Europe and the mechanical loom was developed. In this the weaving of carpets was closely allied to the weaving of tapestries. The French and Flemish pioneered this industry but were followed closely by the Scotch who played an important part in perfecting the machinery essential to mechanical production, and repetition of pattern. So we have the Brussels weave leading up to the Wilton or Moquette, and later the Axminster and Chenille.

Forming the Pile

A combination of wool, cotton, jute and dyestuffs are required in carpet manufacture. The pile, which is that material which gives substance to the carpet to impart that feeling of depth when walked upon, is of pure wool. Special wools of a high degree of resiliency are necessary to form a durable pile for this latter must spring vertically as well as laterally. Lateral spring assures a firm pile.

In the oriental rug the pile may still be developed by tying a multitude of knots and then shearing to uniformity. Simultaneously the pattern is developed. In modern rug weaving, however, the pattern is formed more automatically. In the weaving of Wiltons and velvets a series of wires form part of the loom. Over these the yarn is woven to form a continuous series of loops. These latter may or may not be cut at the time of removal of the wires. When uncut, round wires are used and the process involves loop-pile weaving. In the Axminster loom, in turn, the pattern is introduced by the insertion of the individual pile tufts which are withdrawn and cut from spools actuated through the tube frame and its mechanism.

In the so-called velvet weave, however, the wires carry knife edges, which automatically cut the loops upon withdrawal. In either type of weaving the height of the pile is controlled by the height of these wires.

Later the pile is cropped or sheared to an even height. This process has been likened to a lawn mowing operation. It accomplishes mechanically and with great rapidity what the orientals do most tediously by hand. Several stages of shearing may be necessary to develop the desired velvety appearance in a high quality rug.

THE WOOL STOCK

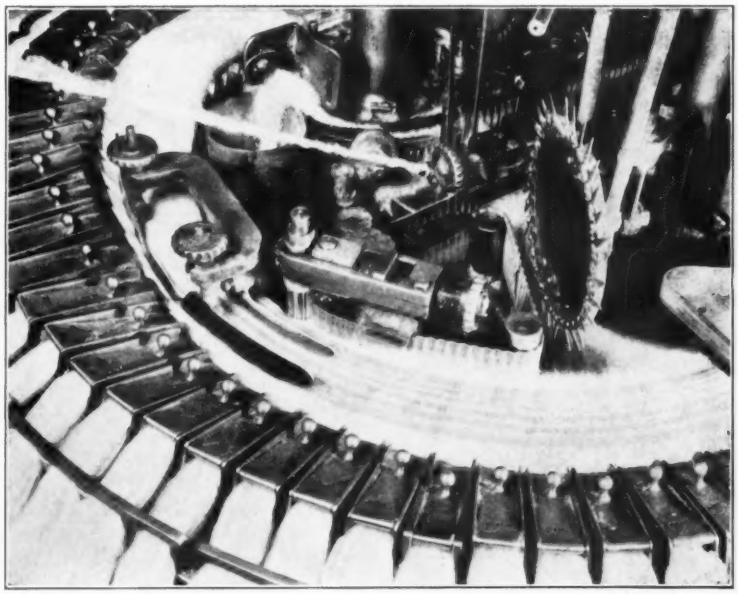
Many modern carpet mills will sort, scour, card, comb and spin their own wool, although they may purchase the necessary jute and cotton yarn from spinning mills in these allied industries. Others will purchase their carpet yarns from specialty spinners. The reason for such care in the preparation of the wool stock is the necessity for obtaining as uniform a yarn as possible and one which will contain only wools of tough, wiry texture; this assures of durability of the pile.

One should, therefore, know something of the treatment to which these raw products are subjected before the yarns are ready for weaving. Too many of us have regarded the manufacture of carpets as primarily a weaving process. There is far more to it than this, although weaving is naturally the most historic and spectacular of the operations. Later, in addition, the woven product must be steamed to give life and straightness to the pile, preparatory to shearing which crops the tufts to even height.

The Axminster Weave

The relative value of certain types of carpets or rugs may to some extent be measured by the wool content. In the Axminster this appears entirely in the pile, the entire backing or body

of the rug being of cotton, jute or a combination of both. The durability of the pile in an Axminster will depend upon the tightness of the weave or the number of rows per inch. Since the wool yarn is just looped around the backing warp, the tufts can often be easily pulled out in loosely woven materials. In reality, this is the test for quality in such a carpet. On the other hand, while the Axminster will contain less wool than a Wilton, if the pile is heavier, higher and more dense, the ultimate wearing qualities may be much better. The number and quality of the colors also affects the rug value; a beautifully designed Axminster with forty colors in the top being of more value than another of the same weight, but possessing only eight colors.



Courtesy of Bigelow-Sanford Carpet Co., Inc.

Fig. 3—The worsted comb involves another preliminary step to which wool must be subjected. This device removes short fibres and straightens and parallels the longer fibres. It must be carefully lubricated due to the proximity of its numerous intricate working mechanisms to the wool under treatment.

The Wilton

The Wilton may contain from five to six times as much wool in the body, and unseen, than appears in the pile. The weaver denotes this by the number of "creels" or racks which carry the spools of yarn. Six of these "creels" are commonly used in the manufacture of a high grade Wilton. From these spools of vari-colored yarns the pattern is formed by the operation of an intricate jacquard mechanism which raises the various threads of the yarn warp in a pre-determined manner. Meanwhile the loom is simultaneously weaving this plus the filler or crosswise threads into the cotton or jute yarn which is taken from a beam or roll below the yarn threads.

Velvet Weaving

Velvet carpet is another type of fabric where wool constitutes a goodly percentage of the backing. Velvet carpeting will usually be woven in plain colors on a standard type of plain loom, but one equipped with a wire mechanism similar to the Wilton loom, for in such weaving the loops are likewise cut to form the pile.

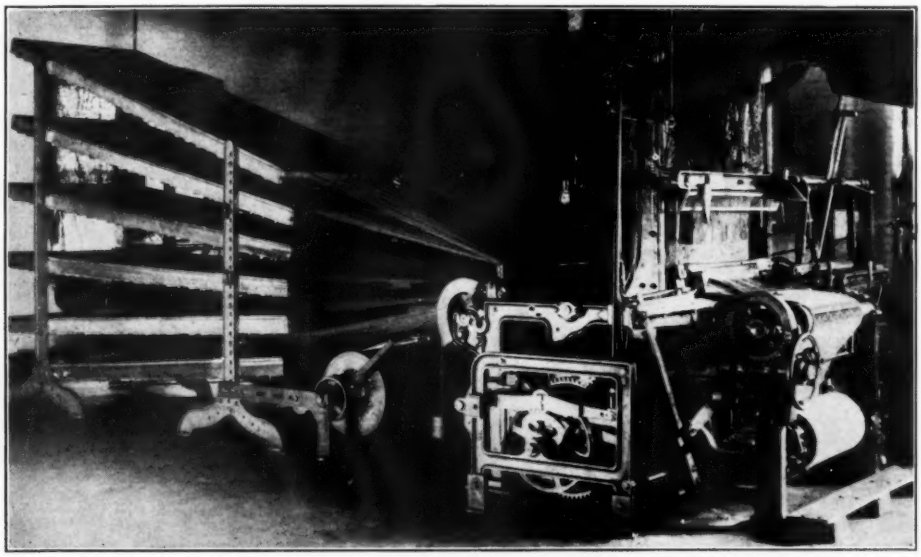
Chenille Fabric

Chenille is another distinctive type of fabric which requires special loom design. Here the weaving surface or pile is woven or built up on

Courtesy of Mohawk Carpet Mills, Inc.

Fig. 4—The spinning mule in woolen yarn spinning. On this machine the spindles present probably the chief problem of lubrication for oil throwing must always be prevented.

narrow weft looms. Later this fabric is cut into weft or crosswise strips which are set or combed into the warp on a broadloom. After preliminary weaving of the pile or weft fabric, during which process the pattern is formed, the material is then taken to the cutting machine which cuts it into strips. These latter are then steamed, dried and passed over forming grooves to shape the tufts and straighten the pile. In long lengths these strips (which are termed "fur") are then ready for combing into the warp on a broadloom. From one to five threads of filler are added for each length of chenille weft to give body and firmness to the carpet. The filler controls the durability, while the width of the strips of weft control the height of the pile. Chenille weaving requires considerable hand work, it is slow and costly, but productive of very high quality fabric.



Courtesy of Mohawk Carpet Mills, Inc.

Fig. 5—Showing the relative location of the yarn creels to a Wilton loom. Each creel carries spools of a different colored yarn.

PREPARATION OF THE YARN

Scouring is the first treatment to which raw wool is subjected after clipping and sorting. It is essentially a cleansing process whereby the product is either washed with soap and alkaline solutions, or treated with a solvent such as naphtha. The purpose in either case is to remove vegetable matter, dust, dirt and grease.

Carding, which follows the process of scouring and drying, opens out the fibres and renders them parallel as far as possible. It involves passing the wool between feed rollers and cylinders surfaced with numerous small wire ends. These wires are held in place by leather or cloth backings in which they are set. There are a number of such cylinders varying in direction of rotation, speed and diameter.

They subject the wool to a continued carding and stripping action always in the same direction, which serves to disentangle and lay the fibres parallel. As the wool passes over the last roller, or doffing cylinder, it is removed by a doffing comb which vibrates across the surface of this roller. The wool at this stage resembles a fibrous veil. It is then condensed into the form of a continuous rope or "sliver" by being led thru a funnel-shaped orifice, to be ultimately wound into balls ready for gilling and back-washing.

The first treatment which takes place in the backwasher involves a mild washing process. It requires the passage of a number of slivers through suitable washing baths to remove any remaining foreign matter. They are then drawn through a dryer and automatically combined into one. Following this a number of the resultant slivers are subjected to drawing or reduction by passage through a series of gill boxes. In these latter the product is passed through rollers and between the vertical steel pins of the fallers. In this way the slivers are flattened and drawn down in diameter; ultimately the product passes through a condenser funnel to be once again brought to the form of a sliver. A number of such gilling treatments may be necessary according to the nature of the stock.

Combing

These slivers are ready for combing after sufficient drawing, etc., in the backwasher,

drying and preliminary gilling. The combing process constitutes the removal of shorter fibres which are not capable of suitable spinning, and final straightening or paralleling of the remaining long fibres. It is a process distinctly applicable to worsted yarns.

The resultant product as it passes from the comber is known as a "top." Frequently it is passed through a finisher gill before winding into a ball suitable for drawing.

The short or waste fibres which are removed are known as "noils." They will usually contain oil which has been added to the wool in gilling to facilitate combing. In consequence the resultant "tops" can be aged or stored with usually perfect safety, especially where compounded mineral oils have been used for conditioning purposes. If emulsifiable compounds containing fixed oils have been employed, there will be a possibility of rancidity, gumming, oxidation and spontaneous combustion occurring. As a result they must be used as sparingly and evenly as possible. This also applies to mineral oils, but from another angle. These latter products if used to excess will tend to cause staining and discoloration of the wool during storage, and also the possibility of a certain amount of gumming.

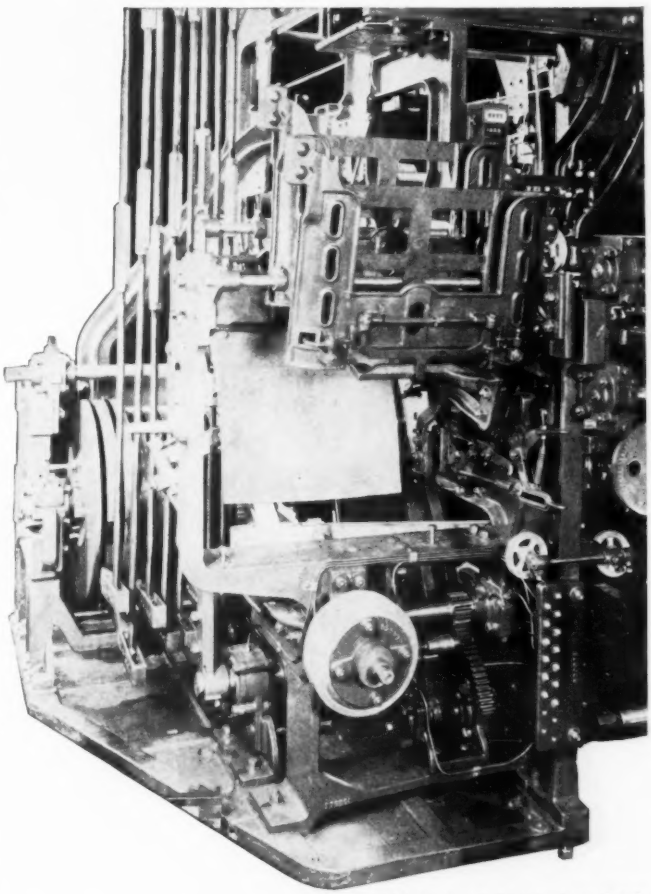
Drawing and Spinning

Up to this stage the purpose has been to prepare, parallel and straighten the fibres for spinning. Dependent on the nature of the stock, the subsequent drawing processes will involve a number of steps. By a series of such drawing operations, several slivers are condensed down to one, each successive operation reducing the product in fineness. The final drawing is carried out on a roving machine which gives the requisite amount of preliminary twist for spinning. This is likewise a process more particularly applicable to worsteds.

Mule Spinning of Woolen Yarns

The spinning mule is a long and wide machine on which drawing and twisting are practicable. The roping is wound on jack spools at the back of the machine, usually in three or four tiers, or on long beams or spools. From here it is passed between drawing rollers. Coming out of the rollers it is fed to the spindles on the mule which backs away from the frame and recedes somewhat faster than the roping is unwound. This receding is the essential motion of the machine, for thus the material receives its final drawing. The spindles, meanwhile, are revolving rapidly, spinning the yarn. The twist goes first to the thin places where the least resistance is offered. Then, as the mule carrying the whirling spindles continues to back away, the thicker parts of the thread, being comparatively untwisted, are pulled down to the average diameter and subsequently twisted.

At the termination of the run or stretch of the mule, the spindles increase their speed until the twisting is completed, then the mule starts on its return trip. This reverses the spindles, the slack being taken up by one guide wire while the other guides the thread to the winding point, and winds it up in the opposite direction on the cone-shaped cops or bobbins on the spindles. The rollers do not feed out more roving as the mule returns, hence, there is no slack when the round trip is completed. Following



Courtesy of Crompton & Knowles Loom Works

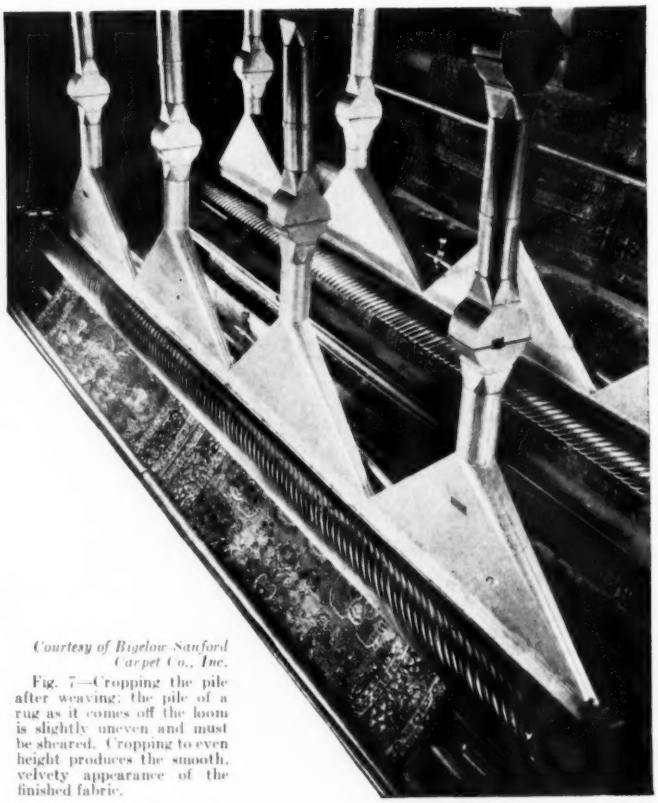
Fig. 6—Close up of a modern carpet loom designed for automatic centralized lubrication of the major bearings. Lubricator panel is shown at lower right of the machine.

the process of spinning the yarn is wound onto suitable spools, etc., preparatory to weaving.

COTTON AND JUTE

These materials form the tie-in or backing of the mechanically woven carpet. Either may be used independently of the other or in various combinations according to the quality and type of fabric involved. Both impart strength and durability to the backing of the carpet to thereby protect the pile from undue wear.

Most of the carpet mills will usually purchase both these materials in the ball, after the fibres have been drawn, twisted and spun into yarn, although some may subject their cotton to additional spinning where a very tight twist is necessary for the backing of the type of fabrics they may be manufacturing.



Courtesy of Bigelow-Sanford Carpet Co., Inc.

Fig. 7—Cropping the pile after weaving: the pile of a rug as it comes off the loom is slightly uneven and must be sheared. Cropping to even height produces the smooth, velvety appearance of the finished fabric.

How Jute is Obtained

This basic material, like the idea, originated in the East. In other words, jute yarn, is made up from a vegetable fibre which is grown almost entirely in India. It is cultivated much like the sugar cane, but is grown primarily under water. The raw fibres are stripped from the cane by native labor accustomed to working in water up to the hips—perhaps this is the chief reason why jute is not grown in other localities. Labor must stand up to work, and at the same time must be content to live on a few cents per day.

Jute is primarily a textile material. As such, it is treated in much the same manner as cotton in its preparation for weaving. It is received by the jute mill wound in "heads" which are packed in 400-lb. bales. These bales are opened and the heads straightened in an opening room much like the opening room in a cotton mill.

Courtesy of Bigelow-Sanford Carpet Co., Inc.

Fig. 8—Velvet weaving in the making showing the wires over which the yarn is woven, the razor-edge on each (at the left) which cuts the loops, and the shuttle (in phantom) between the Vee of the warp. Loop-pile is made by omitting the knives from the wires.

Throughout all subsequent treatment, the basic purpose is to straighten and parallel the fibres, and later to twist and spin them into yarn or twine. The first machine treatment subjects the raw fibres to the rending action of a series of corrugated rolls. At the same time the product is treated with a mineral oil emulsifying compound. Following this treatment, the fibres are packed in an aging cabinet to allow for a certain amount of chemical reaction between the fibres and emulsion. After perhaps 36 to 48 hours of aging, the fibres are ready for carding.

The jute card is a more severe machine than the cotton or woolen card, due to the tough nature of the fibres. For this reason, the card

clothing is equipped with somewhat coarser needles. By varying the speed of the card rolls the jute fibres are straightened and combed so effectively that the lap as it comes off the machine looks much like coarse wool.

Repeated drawing on successive cards reduce the size of the lap and coarseness of the fibres until a lap of suitable size for twisting is obtained.

From the card a series of twisting and rough spinning operations connect the above mentioned laps into yarn or twine according to the purpose for which the material is to be used. The rug or carpet industry requires a yarn of considerable twist for weaving purposes. The strength must also be of high test for jute forms a goodly percentage of the backing or base of our modern Wilton and Axminster rugs. As such it must be able to absorb shock and withstand wear, otherwise the durability of the wool pile or exposed surface of the rug will not stand up as intended.

Courtesy of Mohawk Carpet Mills, Inc.

Fig. 9—Bird's eye view of a 9-foot seamless Jacquard Wilton loom. Note (at lower left) the wire mechanism; the Jacquard cards above the operator, and the warp coming into the loom.

THE LOOM

The loom is the base machine of the rug and carpet industry. It is quite apparent that the modern loom which handles the warp and filler entirely mechanically is a far cry from the primitive hand loom of the ancients which was in use for so many centuries. Civilization materially contributed to this transition and the adoption of mechanical methods for carpet weaving. Civilization at about the same time was developing crude lubricants to keep these new contraptions operating.

We knew pretty early in the last century that machinery involved wear, and ultimately that wear required parts replacement. This is always costly and a necessity to be postponed whenever possible.

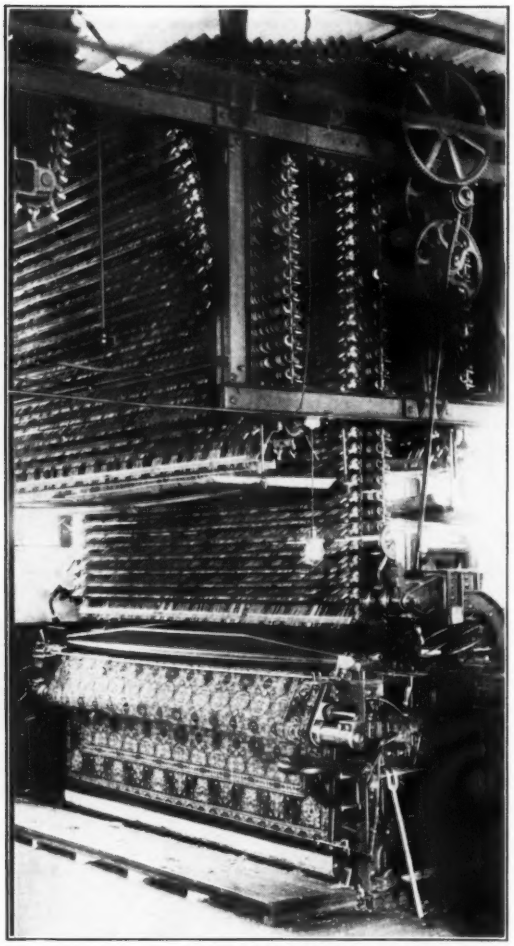
It was only natural, therefore, to adapt certain of these lubricants to the loom mechanisms in use at the time, and later to study the design of the latter to keep pace with the progress made by the petroleum industry.

The carpet loom is not a high speed machine, nor is it a difficult machine to lubricate provided an adequate amount of lubricant is applied to the various gears, cams, chains, and bearings. It is of necessity, however, a machine whereon many of these parts must remain exposed or but partly guarded, so accumulations of fluff or lint will be bound to occur, these becoming oil-soaked may mislead the operator as to the condition of the adjacent parts, or at least make him careless of their importance. The result is that many parts of the loom may not receive adequate lubrication, nor lubrication frequently enough to preclude wear. But lately there has been a definite trend towards the adoption of unit or multiple types of automatic lubricators. These are normally easier for the operators to handle and certainly more protective, provided they are kept reasonably full of lubricant and adjusted to assure of adequate flow. Yet they still remain as a part of the loom itself.

Anti-Friction Bearing Lubrication

With the extension of the roller bearing loom, pressure grease lubrication for bearings is becoming more and more adopted today. The selection of a suitable grease for such mechanisms may present an added problem especially where the bearings are well sealed and where it is desired to provide economy by extending the length of time between greasings. Under

such conditions a highly stable, non-separating type of grease should be used. Its chemical stability will be a measure of its resistance to oxidation. Likewise, if it resists oil separation the possibility of hard soap deposits developing will be minimized.



Courtesy of Alexander Smith & Sons Carpet Co.

Fig. 10—An Axminster loom showing mounting of frames from which wool yarn is taken to form the pattern and pile of the carpet or rug being woven.

In applying any such lubricants, care should be exercised to avoid over-filling. It is very easy to pump more grease than is necessary through a pressure gun fitting. When delivered to a plain bearing, this excess will only work out along the shaft. In a ball or roller bearing, however, it may build up sufficient pressure to impair the seal and cause subsequent leakage. Normally, a ball or roller bearing should be charged only about half-full of grease.

Types of Lubricants

Medium viscosity straight mineral oils, or light greases will function in loom bearings according to the type of lubricant for which they are designated. A loom oil will usually range from 250 to 500 seconds Saybolt viscosity at 100 degrees Fahr. Within this range it will adequately protect all plain bearings and small pin mechanisms.

Throwing of oil is regarded as a serious matter by most weavers, especially where plain carpet is involved. Ordinarily oil spots will not be visible at the time the carpet is made. Furthermore, washing and finishing does not assure of removal, hence such spots may remain (invisible for the time being) to reappear later especially where the goods are exposed to direct sunlight and dirt has been absorbed, the only remedy then is to wash with solvent. In some types of weaving, however, oil spotted yarns may be buried in the backing or tuft of the pile. Here quite a considerable amount of oil would be necessary to show up objectionably. As a result, to be on the safe side many weavers would rather use grease than oil, applying same by pressure gun through suitable fittings.

Gears, Chains and Cams

All such elements are normally served by medium fluid, straight mineral gear lubricants, refined to a high degree of adhesiveness to assure of resistance to centrifugal force. Some greases also possess this property to a marked degree and are used for lubricating cam surfaces.

A most interesting development in cam and gear lubrication has involved the design of a pressure oiling system whereby a stream of oil is continually pumped to the cam and gear tooth surfaces while the loom is in motion. As it flows off it accumulates in a drain pan and then passes to a storage tank for settling, from which it is recirculated by a plunger pump.

THE JACQUARD MECHANISM

The Jacquard loom is used in the manufacture of Wiltons, velvets, and any other pattern carpet fabrics where a loop forms the basis of the pile. The Dobby loom, so familiar to the cotton or worsted weaver, is only used in the carpet mill for weaving chenille fabric which is later cut into strips and combed into a warp backing on a similar type of broadloom.

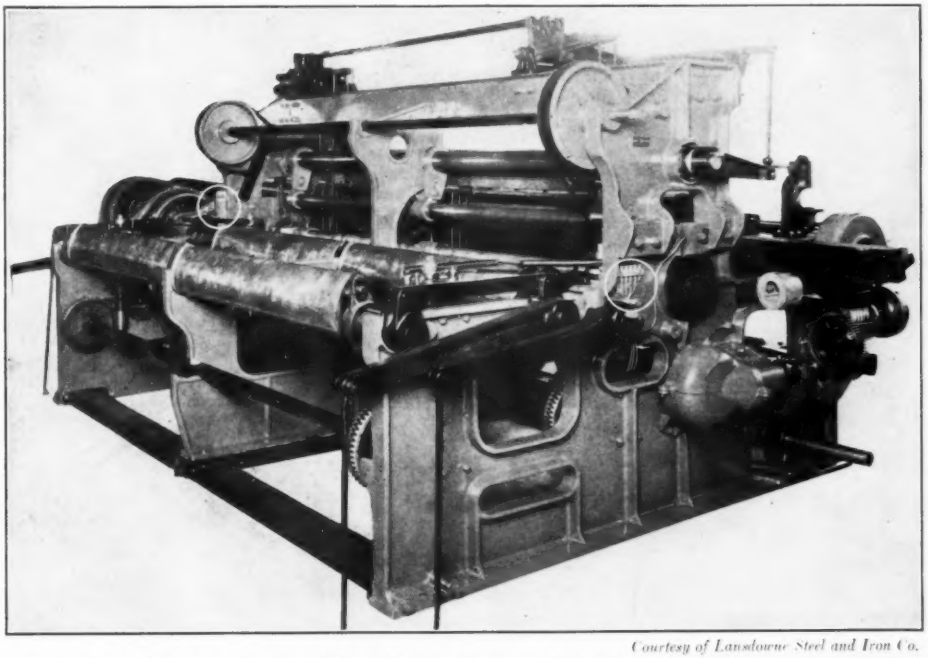
The Jacquard has proved especially adaptable to this industry due to the wide range of color and pattern combinations which can be developed. In the operation of this machine cards are employed in forming the pattern. These cards are perforated much like a roll of music for a player piano. These perforations control the pattern. In other words, each series of warp threads are lifted individually by its own connections, being determined according to the repetition of the pattern across the fabric.

Each thread passes through an eyelet termed a mail eye, in its respective harness connection, the bottom of which is weighted to draw it taut.

The actual raising and lowering of the warp according to the pattern requirements is accomplished by lifting or lowering the harness cord to which the mail eye is connected. These cords are led through a perforated board above the loom in order to keep them in proper position, and are attached to upright wires arranged in rows on the Jacquard machine overhead. The upper ends of these wires are hooked over to engage with a knife-edge which is in constant up-and-down motion. Adjacent to each vertical hook is a horizontal cross-wire to engage with the knife-edge and to be raised to lift its connecting cord and corresponding pile thread. This enables the latter to pass over one of the loom wires below and become looped and eventually part of the pattern.

Jacquard Lubrication

Jacquard machines require considerable care in their lubrication, and it is very necessary to always use high grade lubricants and to apply them intelligently. A light straight mineral oil is preferable for this mechanism, although some operators would rather use a high grade light grease. The latter will not drip as rapidly, but may be more difficult to apply economically.



Courtesy of Lansdowne Steel and Iron Co.

Fig. 11—Front view of a modern loom designed for automatic pressure lubrication. Circles indicate two of the points of assembly of lubricator fittings, the piping from which can be clearly traced. The designers of this loom have made other advancements in the interest of protected lubrication by guarding gears wherever practicable.

capable of moving lengthwise and freeing the hook when necessary. The opposite ends of these horizontal wires project upon a rectangular revolving cylinder, each side of which is drilled with holes to correspond to the position of the wires. Over this cylinder the perforated Jacquard cards pass when the loom is in operation.

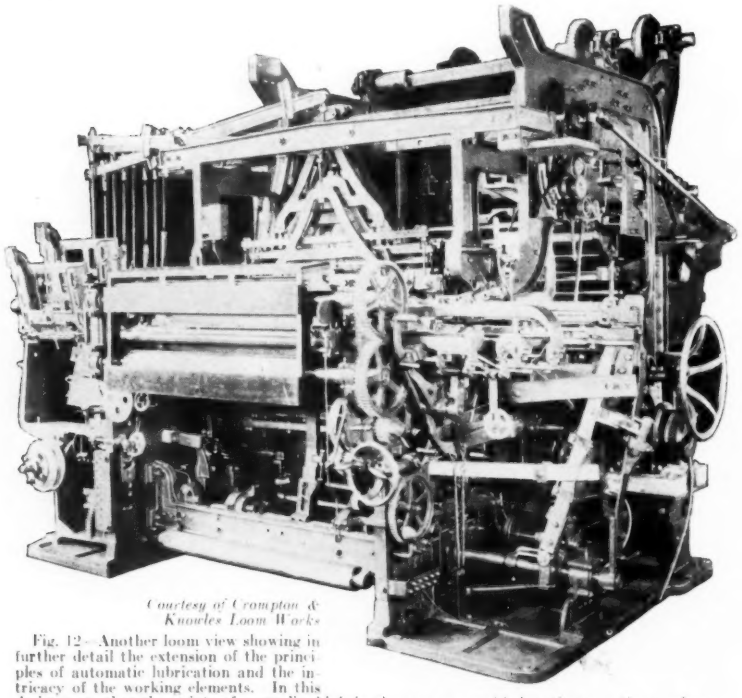
These cards are punched in accordance with the design to be woven, there being one card for each pick or pile thread in the fabric. As each card passes over the perforated cylinder it is pressed against the free ends of the cross wires and wherever there is a hole in the card the respective wire is enabled to pass through. This allows the adjacent upright hooked wire

Excessive lubrication should always be guarded against, due to the detriments which would result from dripping. So oil should never be poured in excess upon the wires, cylinder hammers or other working parts, for it would undoubtedly run down onto the harness connections. The presence of oil on these latter will tend to promote deterioration of the cords and result in breakage. As a protection against oil spots some operators prefer to locate drip pans below their Jacquards.

FUNCTION AND LUBRICATION OF THE WIRE MECHANISM

Mention has been made of the wire mechanism. In further detail this is the determining

factor in controlling the height of the pile. We have already seen that the wires may or may not cut the loop or pile as each wire is withdrawn. The mechanism which withdraws these wires and later inserts them into new position with respect to the warp is of interest to those concerned with lubrication, for one must lubricate not only the sliding rail over which the reciprocating element passes, but also the wires themselves.



Courtesy of Crompton & Knowles Loom Works

Fig. 12—Another loom view showing in further detail the extension of the principles of automatic lubrication and the intricacy of the working elements. In this design note that the points of centralized lubrication are grouped below the operating mechanisms, on the main frame of the machine.

On broadlooms these wires are operated by a rope and chain mechanism, the rope drawing the wires into position, the chain pulling each one subsequently through its series of loops. This latter step may develop a lot of heat and cause discoloration of the warp, so each wire must be lubricated by drawing it over paraffine each time it is pulled through a series of loops.

Narrow fabric looms, however, will not require such an intricate wire mechanism. On these units chains and ropes are unnecessary, a more simple lever mechanism being adequate. While this latter eliminates the necessity for chain link lubrication, it involves added pin and bearing mechanisms, which, like the rail, are best lubricated by a light viscosity white oil to obviate the possibility of oil stains on the fabric should drip or throw occur.

THE PROBLEM OF TEMPERATURE

This is only encountered by the carpet weaver in his finishing processes, and the cutting of chenille strips. In both instances steam heat is applied for straightening of the warp. On the chenille cutter steam is blown directly through the fabric. In the finishing of velvet fabrics, however, passage over steam heated rolls may suffice, although it is equally practicable to blow steam right through the material. In this case the pile must be straightened to facilitate shearing as already mentioned. Lubrication of bearings adjacent to these steam outlets may sometimes present a problem due to possibility of unsuitable lubricants being thinned-down to such an extent as to drip, or throw onto the fabric. Steam joints must also be lubricated.

Usually mechanisms of this type will be best protected by a high melting point grease or steam cylinder oil, applied in accordance with the design of the bearing or joint. As live steam is generally used, temperatures may approach 300 degrees Fahr., at the points of lubrication. Obviously the lubricant must not become too fluid under such conditions otherwise its retention in the bearing or steam joint may be affected. A sufficiently high melting point in any grease for such service will also assure of better chemical stability and resistance to oxidation or oil separation.

IN THE DYE-HOUSE

Dye-house machinery is necessary in the rug or carpet mill for dyeing of raw stock and also woolen and worsted yarns before weaving. This latter is normally termed skein-dyeing. On the other hand some mills will also piece-dye to some extent after weaving. In the lubrication of dye-house machinery one may be confronted with chemical as well as mechanical problems. As a rule, lubrication in the dye-house will extend back to the power plant and the matter of steam cylinder lubrication, especially where condensate or exhaust steam is used in open feed water heaters to raise the temperature of certain of the process waters.

In the dyeing of carpet wools, the softest water obtainable should be used. This will enable saponification and thorough removal of any oily material before it can react to affect

the take of the dye. Oily matter may enter the condensate from the reciprocating mechanisms lubricated by steam cylinder oil. In other words, oil as prepared for average steam conditions will contain in the neighborhood of 4 to 10 per cent. of some animal fat such as lard oil, tallow or degras. These are used in compound to form an adhesive lubricating film to resist the washing action of any condensate or moisture which may be contained in the steam. Such oils are necessary whenever steam reciprocating pumps, engines or air compressors are in operation. If these oils are used to excess they may be carried over by the exhaust steam and, dependent upon the manner in which this latter is used, may concentrate in boiler feed water or process water.

When the original feed water may contain an appreciable amount of calcium and magnesium sulfates or carbonates, reaction may occur between these salts and the animal or fixed oil component in the cylinder oil to form insoluble soaps. If these latter are returned to the boiler with the make-up water, deposits may occur on the water side of the heating surfaces to ultimately cause uneven heat transfer and damage to the tubes.

Of more importance to the dye-house operator will be the effect which these soaps may have on the take of the dye. For this reason the modern carpet mill endeavors to obtain soft water and to observe most carefully the manner in which this water is heated, also the manner in which steam elements are lubricated. Soft water can be most dependably obtained by subjecting the water for plant service to special water softening treatment. The matter of lubrication becomes more mechanical and it is up to the operators to guard against use of an excessive amount in any steam operated mechanism. Later, of course, oil can be separated to some extent from the exhaust steam by passing the latter through a properly designed oil separator.

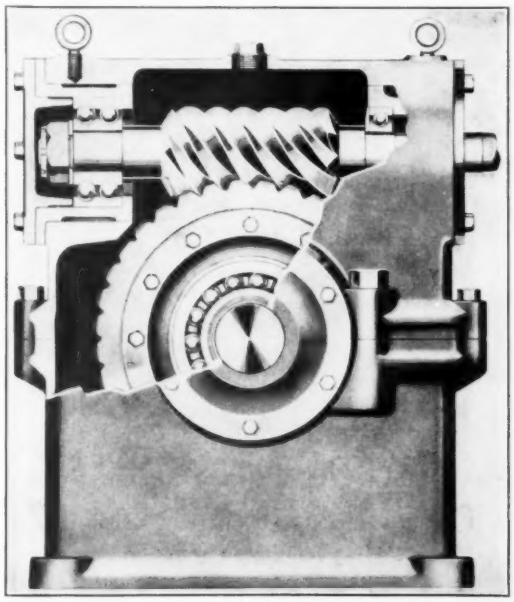
Handling Steam for Heating Purposes

In many operations, live steam of comparatively low pressure will be necessary to develop the required amount of heat in certain dyeing operations, also for rinsing. On the other hand if there is a sufficient supply of exhaust steam of around 8 to 10 lbs. pressure it may give enough heat especially if lead directly into open heating tanks. The use of steam in open tanks, however, is only advisable where one is comparatively sure that it is free from any excessive amounts of sulfates or carbonates and from lubricating oils. To avoid these contaminants, live steam is preferred by many operators. One can be entirely free from any detrimental results, however, by using steam heating coils in all vats where hot solutions or wash waters are to be used. This will eliminate any possibility of oil getting into the goods to exert any contaminating influence.

Over-head Lubrication

Wherever operating mechanisms are installed above washing, coloring or bleaching vats, lubrication must be given most careful attention. Lubricants should never be allowed to drip into the vats and perhaps come in contact with the yarn. This can be prevented by using lubricants of adequate body and by applying them sparingly. The latter can be best assured by use of automatic methods of lubrication as, for instance, pressure grease gun fittings on all bearings. Gears in turn must normally be lubricated by hand since they are usually partly or entirely exposed. For these elements a comparatively heavy gear lubricant up to perhaps 1000 seconds Saybolt universal viscosity at 210 degrees Fahr., will be best. The same type of lubricant can also be used for any driving chains which may form part of the mechanical equipment in the dye-house.

In the lubrication of over-head parts above any of the vats in the dye-house, one must always consider the contaminating effects of moisture and the viscosity reducing effects of temperature when selecting lubricants for these elements. Very often the normal room tempera-



Courtesy of Foote Bros. Gear and Machine Corp.

Fig. 13—Effective power transmission is of much importance in the modern carpet mill. In this connection the worm gear speed reducer has found ready acceptance. The constructional features of the above view give an excellent idea of the provisions the manufacturer has adopted for protection of the working parts and incidentally assuring of dependable lubrication.

tures may run as high as 125 degrees Fahr.; so lubricants must be selected accordingly. For oil lubricated bearings, a viscosity in the neighborhood of 500 seconds at 100 degrees Fahr., will be advisable, a medium bodied, light colored, grease being best for pressure gun or cup service.

Other dye-house machinery, such as electric motors, hydro-extractors, etc., will involve but relatively little difficulty in the lubrication of their bearings; furthermore, they are normally well housed and provided for relatively automatic lubrication. Electric motors may require oil or grease according to whether ring oilers, wick feed elements or anti-friction bearings are used. Hydro-extractors on the other hand are usually oil-lubricated. These mechanisms will only require attention at perhaps monthly intervals and then simply for the purpose of renewing the amount of lubricant to make up for any which may have leaked out in passage through the bearings.

Every six months, however, or perhaps more often, according to the type of service, it will be advisable to flush any automatically lubricated bearing to be sure that contaminating materials are not accumulating and that any emulsions which may have developed through leakage of moisture are removed. It must be remembered that the humidity in the dye-house is very high and that there is often considerable opportunity for condensation which may materially affect lubrication.

Protecting Lubricants in Storage and Handling

Those characteristics of lubricants which should be investigated when making initial selection for various types of operation are familiar to all mill executives. If properly considered there will be assurance that the usual operating conditions will be met with comparative satisfaction. Viscosity, pour test or flash point, for example, will be of decided advantage in denoting how an oil will function at certain temperature extremes, and what its body will be. They will not indicate, however, as to just how an oil will resist contamination when exposed to foreign matter. Where this latter is involved, the problem will be to study storage and handling conditions as well as the construction of wearing elements, to determine the most suitable type of guards, containers, or housings, and to establish rules for handling.

Possibility of contamination in storage will largely depend upon the location of the oil house or oil room and the nature of its construction. If located adjacent to the yard hoist, or in a corner of the power plant building, where doors or windows must be left open, or when they are poorly screened, air drafts may often cause circulation of considerable abrasive dust or dirt. It will be only necessary to leave oil or grease in open containers for a short time under such conditions to result in absorption of whatever dust may settle on the surfaces. Inasmuch as virtually any type of dust is abrasive, lubricants which have been thus contaminated will very frequently tend to promote wear, by virtue of their dust content, rather than leading to its reduction by reason of their lubricating ability. To prevent all this, lubricants should be stored in enclosed tanks or drums, with tightly fitting covers on all containers which have removable heads. If the further precaution is taken to draw oils only into clean distributing containers, and in just sufficient amounts to cover immediate requirements, contamination at the point of distribution can be even more positively prevented.

Fluid oils can be more easily kept free from contamination during storage than greases. Where these latter are involved, the possibility of water contamination must always be guarded against. Certain greases, according to their nature and the purpose for which they are intended, will contain more or less water. This is usually an accurately determined quantity; should any more gain entry, there will be possibility of some greases becoming decidedly altered from both a physical and chemical nature.

Handling of greases and other heavy or more or less inert lubricants must also be given careful consideration. In view of their consistency they must usually be scooped from the containers by hand. During such a procedure there will be considerable possibility of dirt gaining entry, especially if scoops or paddles have not been kept where they could not gather dust. Dirt may also fall off from dirty clothing.

It is virtually impossible for one to keep clean around certain parts of the plant; as a result all should not have access to lubricant storage. Far better will it be to detail a certain part of plant personnel to work only in connection with lubricants and lubrication. They at least can keep cleaner than many of the others; in addition the keeping of lubrication records, and maintenance of economy in issuing the various products can be practiced. Where a separate space or an individual building is reserved for bulk storage of lubricants, the keeping of records is highly essential.

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